**Unit 2 Part 3 Notes Questions – Macromolecules - Key**

**Vocabulary:** Choose two sets of two vocabulary words from your notes. Define each term in the set and identify a connection between the two terms in the set. The definitions and connections must be in your own words and in complete sentences.

1. Terms: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Definitions and Connection:

2.Terms: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

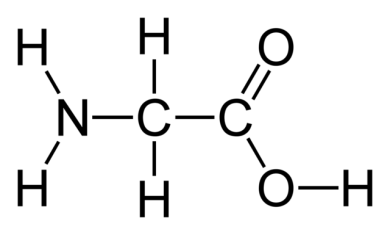
Definitions and Connection:

3. Terms: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Definitions and Connection:

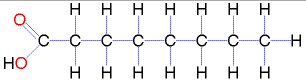
4.Terms: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Definitions and Connection:



1. Identify the functional groups shown in the molecule pictured to the right. Would you assume that this molecule is polar or nonpolar and why?

The molecule pictured to the right contains an amino group (-NH2) and a carboxyl group (-COOH). Technically, the carboxyl group contains both a carbonyl group (C=O) and hydroxyl group (-OH). Because both the amino group and carboxyl group are polar, this molecule is probably polar.



1. Identify the functional groups shown in the molecule pictured to the right. Would you assume that this molecule is polar or nonpolar and why?

The molecule pictured to the right contains a carboxyl group and a methyl group (-CH3). Because it contains mostly C-H bonds, which are nonpolar, this molecule is probably nonpolar, despite having a polar carboxyl group.

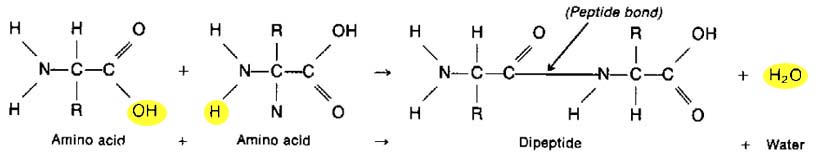
1. Explain how estrogen and testosterone provide evidence that small changes in structure can result in large changes in function. Answer in your OWN WORDS.

A change in only two functional groups bonded to the four ring steroid structure causes estrogen and testosterone to affect the body in very different ways, resulting in female vs. male sex characteristics.

1. Compare and contrast dehydration synthesis and hydrolysis in the chart below.

|  |  |  |
| --- | --- | --- |
| **Dehydration Synthesis Only** | **Similarities between Dehydration Synthesis and Hydrolysis** | **Hydrolysis Only** |
| Dehydration synthesis occurs when monomers are put together to make a polymer (synthesis) and water is lost (dehydration) | Water, monomers, and polymers are involved in both processes | Hydrolysis occurs when water is added (hydro) to break polymers down into monomers (lysis means to break) |

1. Identify the monomers and dimer in the image below. Is this image showing dehydration synthesis or hydrolysis? How do you know?



The monomers (i.e., the single building blocks) in the image are the amino acids (i.e. the building blocks of proteins) on the left side of the equation. The dimer (i.e. two monomers joined together) in the image is the dipeptide on the right side of the equation. This image is showing dehydration synthesis because two monomers are joined together water is lost. You can tell that water is lost because it is on the right side of the equation. If water was on the left side of the equation, that would mean it was added.

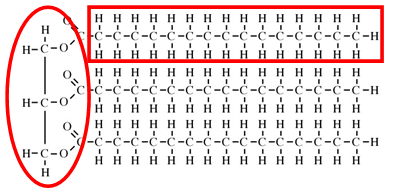
1. Compare and contrast the four macromolecules using the chart below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Carbohydrates | Lipids | Proteins | Nucleic Acids |
| Elements Present | C,H,O (in a 1C : 2H : 1O ratio) | C,H,O (mostly C’s and H’s with a few O’s) | C,H,O,N, and sometimes S (only some amino acids contain S) | C,H,O,N, and P |
| Functions | Short-term energy storage, cell wall structure in plants, structure in insect exoskeletons | Long-term energy storage, protective coatings (ex: the cell membrane), and insulation | **Note: This was NOT in the notes… proteins have many possible functions that include movement (ex: proteins found in muscle tissue), transport (ex: hemoglobin, a protein found in red blood cells that binds to and transports oxygen in the bloodstream), defense (ex: antibody proteins in the human immune system), structure (ex: keratin protein in your hair and nails), and assisting with chemical reactions (ex: enzyme proteins, which speed up reactions)** | Storing and transmitting/sending genetic information (Note: DNA is used to store genetic information and RNA is used to send genetic information from DNA in the nucleus to the ribosome, where proteins are assembled from the instructions in RNA) |
| Monomers (Name and/or Examples) | Name: Monosaccharides  Examples: Glucose, Fructose, Galactose, Ribose, Deoxyribose | Name: Glycerol and fatty acids | Name: Amino Acids  Examples (from the image showing the types of amino acids): Glycine, Valine, and Alanine | Name: Nucleotides |
| Polymers (Name and/or Examples) | Name: Polysaccharides  Examples: Glycogen, Starch, Cellulose, Chitin | Examples: Phospholipids, triglycerides (aka fats), steroids  (Note: steroids do not contain glycerol and fatty acid chains… they have a different structure from most lipid polymers) | Name: Polypeptides (Note: a full protein typically consists of several polypeptide chains folded around each other)  Examples: Hemoglobin, Enzymes, Antibodies, Keratin, etc. | Examples: DNA and RNA |

1. Explain how the structure of cellulose contributes to its function.

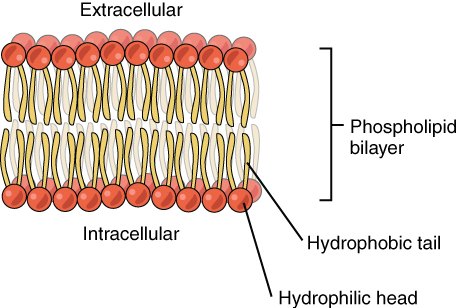
Cellulose contains 1,4 beta linkages, which point in opposite directions, making cellulose chains straight. Hydroxyl groups in parallel cellulose chains are able to hydrogen bond with each other, making tough layers of parallel cellulose fibers. This helps to create a strong cell wall in plants.

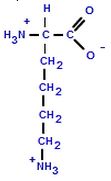
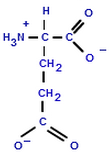
1. Label the glycerol and fatty acids in the image of a fat (aka triglyceride) shown below. Is this a saturated or unsaturated fat, and how do you know?



The portion of the fat molecule shown that is contained within the oval is the glycerol. The portion of the fat molecule shown that is contained within the rectangle is one of the three fatty acid chains. This is a saturated fat because there are no double bonds between carbons and hydrogens in the fatty acid chains. As such, there are no kinks or bends in the chains. They are straight and stack up tightly.

1. How do phospholipid molecules arrange themselves in the cell membrane? Explain why they arrange themselves in this way, and draw a picture of the cell membrane in the box given below.

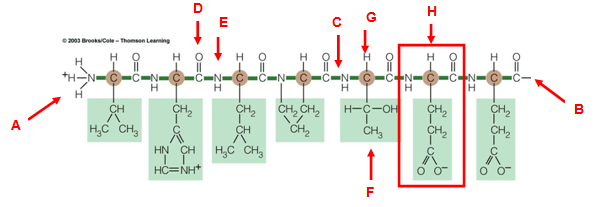
Phospholipid molecules consist of two hydrophobic (i.e. water fearing / non-polar) tails and a hydrophilic (i.e. water loving / polar) head. They arrange themselves in a double layer (aka bilayer) with the water-loving heads facing the mostly aqueous (i.e. water-containing) extracellular fluid (i.e. fluid outside the cell) and intracellular fluid (i.e. fluid inside the cell). The tails try to isolate themselves on the inside of the phospholipid bilayer where they can avoid the aqueous extracellular and intracellular fluid.



1. What type of bond will form between amino acids with R groups that have opposite charges? See images of both amino acids below.

Because the R group on the first amino acid has a full negative charge, and the R group on the second amino acid has a full positive charge, they will be attracted to each other through an ionic bond.

1. In the image below of a polypeptide, label the following components: the N-terminus, the C-terminus, a peptide bond, a carboxyl group, an amino group, an R group, a central carbon atom, and a single amino acid.



A = N-Terminus

B = C-Terminus (this should be a carboxyl group, but the hydroxyl part of the carboxyl group was accidentally cut out of the image)

C = Peptide Bond

D = Carboxyl group (Note: This originally consisted of a full carboxyl group, but the –OH part of the carboxyl group was lost along with an –H from the amino group of the adjacent amino acid to form water lost during dehydration synthesis)

E = Amino group (Note: this originally consisted of a full amino group, but an –H from the amino group was lost along with the –OH part of the carboxyl group on the adjacent amino acid to form water lost during dehydration synthesis)

F = R group (also called a variable group)

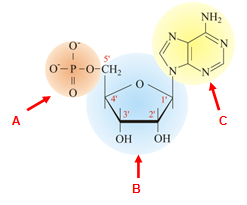
G = Central carbon atom

H = a single amino acid

1. Identify the level of protein structure shown in each of the images below (i.e., primary, secondary, tertiary, or quaternary structure), and provide an explanation for your choice.

|  |  |  |
| --- | --- | --- |
| **Image** | **Level of Structure** | **Explanation** |
|  | Secondary | Hydrogen bonds form between the amino and carboxyl groups of non-adjacent amino acids to create alpha helices and/or beta pleated sheets |
|  | Quaternary | Hydrogen bonds, ionic bonds, covalent bonds, and hydrophobic interactions occur between the R groups ofamino acids on different polypeptides to allow these different polypeptides to fold around each other in a unique conformation to create a full protein |
|  | Primary | Peptide bonds (i.e. a special type of covalent bond) connect the amino groups and carboxyl groups of amino acids to create a single chain of amino acids (i.e. a polypeptide) |
| http://faculty.ccbcmd.edu/~gkaiser/biotutorials/proteins/images/u4fg1b3.jpg | Tertiary | Hydrogen bonds, ionic bonds, covalent bonds, and hydrophobic interactions occur between the R groups of amino acids on the same polypeptide, causing it to fold into unique conformations. |

1. Label the parts of the nucleotide picture to the right.



A = Phosphate group

B = 5-carbon sugar (aka pentose sugar)

C = Nitrogen base (aka nitrogenous base)